

WE CLAIM:

1. An illumination unit, comprising:
a first reflector comprising a first reflecting surface that conforms to a first
5 surface of revolution about a first revolution axis; and
a first light emitting diode (LED) unit having a light emitting area emitting
light about a first LED axis to the first reflecting surface, the first LED axis being non-
parallel to the first revolution axis.
2. A unit as recited in claim 1, wherein the first LED axis forms an angle to the
10 first revolution axis of θ , where $45^\circ \leq \theta \leq 90^\circ$, where θ is the minimum angle between the
LED axis and the first revolution axis.
3. A unit as recited in claim 2, wherein $60^\circ \leq \theta \leq 90^\circ$.
4. A unit as recited in claim 2, wherein the θ is approximately 90° .
5. A unit as recited in claim 1, wherein the light emitting area of the first LED
15 unit is positioned at a focus of the reflecting surface.
6. A unit as recited in claim 1, wherein the first reflecting surface conforms to an
ellipsoid, the light emitting area of the first LED unit being positioned substantially at a first
focus of the ellipsoid.
7. A unit as recited in claim 6, wherein an illumination target is positioned at a
20 second focus of the ellipsoid.
8. A unit as recited in claim 1, wherein the first reflecting surface conforms to a
paraboloid, the light emitting area of the first LED unit being positioned substantially at the
focus of the paraboloid.

9. A unit as recited in claim 1, wherein the first reflector is formed of a transmitting medium with the reflecting surface defined on an outside surface of the transmitting medium, the transmitting medium being positioned between the first LED unit and the reflecting surface of the first reflector.

5 10. A unit as recited in claim 9, wherein the first reflector has a first exit aperture, the transmitting medium having a substantially flat surface at the first exit aperture.

11. A unit as recited in claim 9, wherein the first reflector has a first exit aperture, the transmitting medium having a faceted surface at the first exit aperture.

10 12. A unit as recited in claim 9, wherein the first reflector has a first exit aperture, the transmitting medium having a curved surface at the first exit aperture.

13. A unit as recited in claim 9, wherein the transmitting medium has a concave surface forming a concavity for receiving the first LED unit, at least part of a lens of the first LED unit being located in the concavity.

15 14. A unit as recited in claim 13, further comprising an index matching material disposed between the first LED unit and the concave surface.

15. A unit as recited in claim 13, wherein the first LED unit is optically cemented to the concave surface.

16. A unit as recited in claim 1, wherein the first reflector is formed with the reflecting surface disposed between the first LED unit and a reflector support medium.

20 17. A unit as recited in claim 1, wherein the first LED unit further comprises a hemispherical lens, the hemispherical lens being positioned symmetrically about the first LED axis.

18. A unit as recited in claim 1, further comprising at least a second reflector comprising a second reflecting surface formed as a second surface of revolution about a second revolution axis; and a second LED unit having a light emitting area emitting light about a second LED axis to the second reflecting surface of the second reflector, the second
5 LED axis being non-parallel to the second revolution axis.

19. A unit as recited in claim 18, wherein the first and second revolution axes intersect at an illumination target region.

20. A unit as recited in claim 18, wherein the first and second revolution axes are non-parallel.

10 21. A unit as recited in claim 18, wherein the first and second revolution axes are parallel.

22. A reflector unit for reflecting illumination light, comprising:
a reflector body having a body axis, the reflector body comprising
a first reflecting surface conforming to a first surface of revolution
15 about a first revolution axis; and
a second reflecting surface formed integrally with the first reflecting surface, the second reflecting surface conforming to a second surface of revolution about a second revolution axis, the first and second reflecting surfaces being positioned transversally about the body axis.

20 23. A unit as recited in claim 22, wherein the first and second revolution axes are nonparallel to the body axis and are nonparallel to each other.

24. A unit as recited in claim 23, wherein the first and second revolution axes intersect the body axis at an intersection point.

25. A unit as recited in claim 22, wherein the first and second revolution axes are parallel to the body axis.

26. A unit as recited in claim 22, wherein the first and second surfaces of revolution are ellipsoids.

5 27. A unit as recited in claim 26, wherein the first and second ellipsoidal surfaces of revolution have common foci on the body axis.

28. A unit as recited in claim 26, wherein the first and second ellipsoidal surfaces of revolution have major axes of substantially the same length and minor axes of substantially the same length.

10 29. A unit as recited in claim 22, wherein the first and second surfaces of revolution are paraboloids.

30. A unit as recited in claim 22, further comprising at least a third reflecting surface formed integrally with the first and second reflecting surfaces, the first, second and at least a third reflecting surface conforming to a common surface of revolution about respective first, second and at least a third revolution axes, the first, second and at least a third reflecting surfaces being positioned transversally about the body axis.

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31. A unit as recited in claim 30, wherein the first, second and at least a third revolution axes are parallel to the body axis.

32. A unit as recited in claim 30, wherein the first, second and at least a third revolution axes are non-parallel to the body axis.

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33. A unit as recited in claim 32, wherein the first, second and at least a third revolution axes intersect the body axis at substantially the same intersection point.

34. A unit as recited in claim 30, wherein the first, second and at least a third reflecting surface comprise at least four reflecting surfaces disposed symmetrically about the body axis.

35. A unit as recited in claim 30, wherein the first, second and at least a third reflecting surfaces are aligned to illuminate a target area when the first, second and at least a third reflecting surfaces are illuminated with respective first, second and at least a third light emitting diodes positioned close to focal points of the first, second and at least a third reflecting surfaces.

36. A unit as recited in claim 30, wherein the first, second and at least a third reflecting surfaces form an enclosed shape having an aperture therethrough, and further comprising at least a fourth reflecting surface conforming to at least a fourth surface of revolution about at least a fourth revolution axis disposed to reflect light through the aperture.

37. A unit as recited in claim 22, wherein the first and second reflecting surfaces each comprise a multilayer optical film reflecting surface.

38. A unit as recited in claim 22, wherein the first and second reflecting surfaces define reflecting surfaces for respective hollow reflectors.

39. A unit as recited in claim 22, wherein the first and second reflecting surfaces define reflecting surfaces for respective solid body reflectors.

40. A unit as recited in claim 22, wherein at least one of the solid body reflectors has a faceted exit surface.

41. A unit as recited in claim 22, wherein at least one of the solid body reflectors has a flat exit surface.

42. A unit as recited in claim 22, wherein at least one of the solid body reflectors has a curved exit surface.